No. 200600040

THE UNITED STATES OF AMERICA

TO ALL TO WHOM THESE PRESENTS SHALL COME:

Utah State University

Whereas, THERE HAS BEEN PRESENTED TO THE

Secretary of Agriculture

AN APPLICATION REQUESTING A CERTIFICATE OF PROTECTION FOR AN ALLEGED DISTINCT VARIETY OF SEXUALLY REPRODUCED, OR TUBER PROPAGATED PLANT, THE NAME AND DESCRIPTION OF WHICH ARE CONTAINED IN THE APPLICATION AND EXHIBITS, A COPY OF WHICH IS HEREUNTO ANNEXED AND MADE A PART HEREOF, AND THE VARIOUS REQUIREMENTS OF LAW IN SUCH CASES MADE AND PROVIDED HAVE BEEN COMPLIED WITH, AND THE TITLE THERETO IS, FROM THE RECORDS OF THE PLANT VARIETY PROTECTION OFFICE, IN THE APPLICANT(S) INDICATED IN THE SAID COPY, AND WHEREAS, UPON DUE EXAMINATION MADE, THE SAID APPLICANT(S) IS (ARE) ADJUDGED TO BE ENTITLED TO A CERTIFICATE OF PLANT VARIETY PROTECTION UNDER THE LAW.

NOW, THEREFORE, THIS CERTIFICATE OF PLANT VARIETY PROTECTION IS TO GRANT UNTO THE SAID APPLICANT(S) AND THE SUCCESSORS, HEIRS OR ASSIGNS OF THE SAID APPLICANT(S) FOR THE TERM OF TWENTY YEARS FROM THE DATE OF THIS GRANT, SUBJECT TO THE PAYMENT OF THE REQUIRED FEES AND PERIODIC REPLENISHMENT OF VIABLE BASIC SEED OF THE VARIETY IN A PUBLIC REPOSITORY AS PROVIDED BY LAW, THE RIGHT TO EXCLUDE OTHERS FROM SELLING THE VARIETY, OR OFFERING IT FOR SALE, OR REPRODUCING IT, OR IMPORTING IT, OR EXPORTING IT, OR CONDITIONING IT FOR PROPAGATION, OR STOCKING IT FOR ANY OF THE ABOVE PURPOSES, OR USING IT IN PRODUCING A HYBRID OR DIFFERENT VARIETY THEREFROM, TO THE EXTENT PROVIDED BY THE PLANT VARIETY PROTECTION ACT. IN THE UNITED STATES SEED OF THIS VARIETY (1) MAY BE SOLD BY VARIETY NAME ONLY AS A CLASS OF CERTIFIED SEED AND (2) SHALL CONFORM TO THE NUMBER OF GENERATIONS SPECIFIED BY THE OWNER OF THE RIGHTS. (84 STAT. 1542, AS AMENDED, 7 U.S.C. 2321 ET SEQ.)

BARLEY

'Aquila'

In Testimony Whereof, I have hereunto set my hand and caused the seal of the Plant Variety Protection Office to be affixed at the City of Washington, D.C. this sixth day of February, in the year two thousand and seven.

Attest:

Commissioner
Plant Variety Protection Office
Agricultural Marketing Service

Secretary of Agriculture

REPRODUCE LOCALLY. *Include form number and date on all reproductions* — Form Approved - OMB No. 0581-0055

U.S. DEPARTMENT OF AGRICULTURE
AGRICULTURAL MARKETING SERVICE
SCIENCE AND TECHNOLOGY - PLANT VARIETY PROTECTION OFFICE

APPLICATION FOR PLANT VARIETY PROTECTION CERTIFICATE
(Instructions and information collection burden statement on reverse)

The following statements are made in accordance with the Privacy Act of 1974 (5 U.S.C. 552a) and the Paperwork Reduction Act (PRA) of 1995.

Application is required in order to determine if a plant variety protection certificate is to be issued (7 U.S.C. 2421). Information is held confidential until certificate is issued (7 U.S.C. 2426).

1. NAME OF OWNER
Utah State University

2. TEMPORARY DESIGNATION OR EXPERIMENTAL NAME
UT95B1480-1632

3. VARIETY NAME
Aquila

4. ADDRESS *(Street and No., or R.F.D. No., City, State, and ZIP Code, and Country)*
4820 Old Main Hill
Logan, UT 84322

5. TELEPHONE *(include area code)*
(435) 797-7214

6. FAX *(include area code)*
(435) 797-3376

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PVPO NUMBER
200600040

FILING DATE
11-29-2005

7. IF THE OWNER NAMED IS NOT A "PERSON", GIVE FORM OF ORGANIZATION *(corporation, partnership, association, etc.)*
State University

8. IF INCORPORATED, GIVE STATE OF INCORPORATION

9. DATE OF INCORPORATION

10. NAME AND ADDRESS OF OWNER REPRESENTATIVE(S) TO SERVE IN THIS APPLICATION. *(First person listed will receive all papers)*
Dr. Dominique Roche
Plants, Soils, & Biometeorology Dept.
Utah State University
Logan, UT 84322-4820

FEES RECEIVED

FILING AND EXAMINATION FEES:
$ 3652
DATE 11/29/05

CERTIFICATION FEE:
$ 768.00
DATE 10/24/2006

11. TELEPHONE *(include area code)*
(435) 797-7214

12. FAX *(include area code)*
(435) 797-3376

13. E-MAIL
droche@mendel.usu.edu

14. CROP KIND *(Common Name)*
Barley

16. FAMILY NAME *(Botanical)*
Poaceae (Gramineae)

15. GENUS AND SPECIES NAME OF CROP
Hordeum vulgare

17. IS THE VARIETY A FIRST GENERATION HYBRID?
☐ YES ☑ NO

18. DOES THE VARIETY CONTAIN ANY TRANSGENES? ***(OPTIONAL)***
☐ YES ☑ NO
IF SO, PLEASE GIVE THE ASSIGNED USDA-APHIS REFERENCE NUMBER FOR THE APPROVED PETITION TO DEREGULATE THE GENETICALLY MODIFIED PLANT FOR COMMERICALIZATION. _____

19. CHECK APPROPRIATE BOX FOR EACH ATTACHMENT SUBMITTED
(Follow instructions on reverse)

a. ☑ Exhibit A. Origin and Breeding History of the Variety
b. ☑ Exhibit B. Statement of Distinctness
c. ☑ Exhibit C. Objective Description of Variety
d. ☑ Exhibit D. Additional Description of the Variety *(Optional)*
e. ☑ Exhibit E. Statement of the Basis of the Owner's Ownership
f. ☑ Voucher Sample *(2,500 viable untreated seeds or, for tuber propagated varieties, verification that tissue culture will be deposited and maintained in an approved public repository)*
g. ☑ Filing and Examination Fee ($3,652), made payable to "Treasurer of the United States" *(Mail to the Plant Variety Protection Office)*

20. DOES THE OWNER SPECIFY THAT SEED OF THIS VARIETY BE SOLD AS A CLASS OF CERTIFIED SEED? *(See Section 83(a) of the Plant Variety Protection Act)*
☑ YES *(If "yes", answer items 21 and 22 below)* ☐ NO *(If "no", go to item 23)*

21. DOES THE OWNER SPECIFY THAT SEED OF THIS VARIETY BE LIMITED AS TO NUMBER OF CLASSES?
☑ YES ☐ NO
IF YES, WHICH CLASSES? ☐ FOUNDATION ☐ REGISTERED ☐ CERTIFIED

22. DOES THE OWNER SPECIFY THAT SEED OF THIS VARIETY BE LIMITED AS TO NUMBER OF GENERATIONS?
☑ YES ☐ NO
IF YES, SPECIFY THE NUMBER 1,2,3, etc. FOR EACH CLASS.
☐ FOUNDATION ☐ REGISTERED ☐ CERTIFIED
(If additional explanation is necessary, please use the space indicated on the reverse.)

23. HAS THE VARIETY (INCLUDING ANY HARVESTED MATERIAL) OR A HYBRID PRODUCED FROM THIS VARIETY BEEN SOLD, DISPOSED OF, TRANSFERRED, OR USED IN THE U. S. OR OTHER COUNTRIES?
☐ YES ☑ NO
IF YES, YOU MUST PROVIDE THE DATE OF FIRST SALE, DISPOSITION, TRANSFER, OR USE FOR EACH COUNTRY AND THE CIRCUMSTANCES. *(Please use space indicated on reverse.)*

24. IS THE VARIETY OR ANY COMPONENT OF THE VARIETY PROTECTED BY INTELLECTUAL PROPERTY RIGHT *(PLANT BREEDER'S RIGHT OR PATENT)*?
☐ YES ☑ NO
IF YES, PLEASE GIVE COUNTRY, DATE OF FILING OR ISSUANCE AND ASSIGNED REFERENCE NUMBER. *(Please use space indicated on reverse.)*

25. The owners declare that a viable sample of basic seed of the variety has been furnished with application and will be replenished upon request in accordance with such regulations as may be applicable, or for a tuber propagated variety a tissue culture will be deposited in a public repository and maintained for the duration of the certificate.

The undersigned owner(s) is(are) the owner of this sexually reproduced or tuber propagated plant variety, and believe(s) that the variety is new, distinct, uniform, and stable as required in Section 42, and is entitled to protection under the provisions of Section 42 of the Plant Variety Protection Act.

Owner(s) is (are) informed that false representation herein can jeopardize protection and result in penalties.

SIGNATURE OF OWNER	SIGNATURE OF OWNER
H. Paul Rasmussen	[signature]
NAME *(Please print or type)* H. Paul Rasmussen	NAME *(Please print or type)* Steven J. Kephart
CAPACITY OR TITLE: Director, Ut Ag. Exp. Sta.	DATE: 11-20-05
CAPACITY OR TITLE: VP	DATE: 11/22/05

(See reverse for instructions and information collection burden statement)

ST-470 (04-03) designed by the Plant Variety Protection Office using Word 2002.

INSTRUCTIONS

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GENERAL: To be effectively filed with the Plant Variety Protection Office (PVPO), **ALL** of the following items must be **received** in the PVPO: (1) Completed application form signed by the owner; (2) completed exhibits A, B, C, E; (3) for a seed reproduced variety at least 2,500 viable untreated seeds, for a hybrid variety at least 2,500 untreated seeds of each line necessary to **reproduce** the variety, or for tuber reproduced varieties verification that a viable *(in the sense that it will reproduce an entire plant)* tissue culture will be deposited and maintained in an approved public repository; (4) check drawn on a U.S. bank for $3,652 ($432 filing fee and $3,220 examination fee), payable to "Treasurer of the United States" *(See Section 97.6 of the Regulations and Rules of Practice.)* Partial applications will be held in the PVPO for not more than 90 days, then returned to the applicant as unfiled. Mail application and other requirements to Plant Variety Protection Office, AMS, USDA, Room 401, NAL Building, 10301 Baltimore Avenue, Beltsville, MD 20705-2351. Retain one copy for your files. All items on the face of the application are self explanatory unless noted below. Corrections on the application form and exhibits must be initialed and dated. **DO NOT** use masking materials to make corrections. If a certificate is allowed, you will be requested to send a check payable to "Treasurer of the United States" in the amount of $432 for issuance of the certificate. Certificates will be issued to owner, not licensee or agent.

Plant Variety Protection Office
Telephone: (301) 504-5518
FAX: (301) 504-5291
Homepage: http://www.ams.usda.gov/science/pvpo/pvpindex.htm

To avoid conflict with other variety names in use, the applicant must check the appropriate recognized authority and provide evidence that name has been cleared by the appropriate recognized authority before the Certificate of Protection is issued. For example, for agricultural and vegetable crops, contact: Seed Branch, AMS, USDA, 10301 Baltimore Avenue, Suite 401 NAL Building, Beltsville, MD 20705. Telephone: (301) 504-5682 http://www.ams.usda.gov/lsg/seed.htm.

ITEM

19a. Give:
(1) the genealogy, including public and commercial varieties, lines, or clones used, and the breeding method;
(2) the details of subsequent stages of selection and multiplication;
(3) evidence of uniformity and stability; and
(4) the type and frequency of variants during reproduction and multiplication and state how these variants may be identified

19b. Give a summary of the variety's distinctness. Clearly state how this application variety may be distinguished from all other varieties in the same crop. If the new variety is most similar to one variety or a group of related varieties:

(1) identify these varieties and state all differences objectively;
(2) attach statistical data for characters expressed numerically and demonstrate that these are clear differences; and
(3) submit, if helpful, seed and plant specimens or photographs (prints) of seed and plant comparisons which clearly indicate distinctness.

19c. Exhibit C forms are available from the PVPO Office for most crops; specify crop kind. Fill in Exhibit C (Objective Description of Variety) form as completely as possible to describe your variety.

19d. Optional additional characteristics and/or photographs. Describe any additional characteristics that cannot be accurately conveyed in Exhibit C. Use comparative varieties as is necessary to reveal more accurately the characteristics that are difficult to describe, such as plant habit, plant color, disease resistance, *etc.*

19e. Section 52(5) of the Act requires applicants to furnish a statement of the basis of the applicant's ownership. An Exhibit E form is available from the PVPO.

20. If "Yes" is specified *(seed of this variety be sold by variety name only, as a class of certified seed)*, the applicant **MAY NOT** reverse this affirmative decision after the variety has been sold and so labeled, the decision published, or the certificate issued. However, if "No" has been specified, the applicant may change the choice. *(See Regulations and Rules of Practice, Section 97.103).*

23. *See Sections 41, 42, and 43 of the Act and Section 97.5 of the regulations for eligibility requirements.*

24. *See Section 55 of the Act for instructions on claiming the benefit of an earlier filing date.*

22. CONTINUED FROM FRONT *(Please provide a statement as to the limitation and sequence of generations that may be certified.)*

23. CONTINUED FROM FRONT *(Please provide the date of first sale, disposition, transfer, or use for each country and the circumstances, if the variety (including any harvested material) or a hybrid produced from this variety has been sold, disposed of, transferred, or used in the U.S. or other countries.)*

24. CONTINUED FROM FRONT *(Please give the country, date of filing or issuance, and assigned reference number, if the variety or any component of the variety is protected by intellectual property right (Plant Breeder's Right or Patent).)*

NOTES: It is the responsibility of the applicant/owner to keep the PVPO informed of any changes of address or change of ownership or assignment or owner's representative during the life of the application/certificate. The fees for filing a change of address; owner's representative; ownership or assignment; or any modification of owner's name is specified in Section 97.175 of the regulations. *(See Section 101 of the Act, and Sections 97.130, 97.131, 97.175(h) of the Regulations and Rules of Practice.)*

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Exhibit A – Origin and Breeding History

AQUILA

Summer, 1992:

Original cross made at Logan, Utah, by Dr. Rulon S. Albrechtsen
Cross number was UT97B 1480

UT-S.D.B1-1009/M72-395/3/Utah Short#2//
ID633019/'Woodvale'/4/'Steptoe'/M27//'Westbred Gustoe'

UT-S.D.B1-1009 is a sib to Bracken (Albrechtsen, *Crop Sci.*33: 1413-1414; 1993).

M72-395 is a short stature breeding line involving the parents 'Jotun', 'Kindred' and 'Vantage' (Mohamed, Okiror, Rasmusson, *Crop Sci.* 18: 418-422; 1978)

Winter, 1992-93:

F_1 Plants grown in the greenhouse at Logan, Utah.

There was no segregation observed in F_1 plants.

Summers, 1993, 1994 and 1995:

F_2 through F_4 generation plants grown in the field at Logan, Utah in space-planted (plants 6 inches apart with 12-inch row spacing) modified bulk populations which were selected for plants possessing the following characteristics:

· Four or more fertile tillers per plant in space-planted stands
· Early to mid-season heading date
· Early to mid-season maturity date
· Less than 90 cm tall
· Zero to near-zero lodging
· Upright stems
· Desirable plant confirmation
· Plump seeds
· White aleurone
· Complete exertion of spike from flag leaf at maturity
· Tough (not brittle) stem and neck
· Lemma awns longer than spike
· Moderately free of powdery mildew (caused by Erisyphe graminis DC. F sp. Herdei Em. Marchal)
· Aquila is susceptible to barley stripe rust (caused by Puccinia striiformis Westend)

Selected seed was bulked for each succeeding generation.

Summer, 1996:	F_5 Plants grown at Logan, Utah in a space planted (plants 6 inches apart with 12 inch row spacing) modified bulk population and single heads were selected from 200 plants possessing the same characteristics as those listed for the F_2 through F_4 generations.
Summer, 1997:	Seed from the 200 individual selected heads were grown in F6 head rows at Logan, Utah, where all rows were evaluated for the same characteristics as those listed for the F2 through F5 generations. Only desirable rows were harvested. Seed from harvested rows were subjected to protein evaluation and kernel rating in the lavatory. Row 1632 (identified as UT97B 1480-1632) was selected as a single head row for additional testing. It was found to breed true for rough lemma awns.
Summer, 1998 and 1999:	UT97B 1480-1632 was evaluated for yield and test weight, in addition to the characters listed for the F_6 head rows, in a single-replicate preliminary irrigated yield test (which included Steptoe check plots) grown at Logan, Utah.
Summers, 2000 through 2003:	UT97B 1480-1632 was evaluated for the same characters listed for the preliminary irrigated yield test, in replicated irrigated yield tests at four major irrigated barley production sites in Utah.
Summers, 2001 Through 2003:	UT97B 1480-1632 was evaluated for the same characters listed for the preliminary irrigated yield test, in and the Western Regional Irrigated Spring Barley Nursery.
Summer 2002:	Selected 1000 heads of UT97B 1480-1632 were selected among the F_{5-11} progenies at Logan, Utah to be used for production of Breeder seed.
Winter, 2002-03:	Breeder seed of UT97B 1480-1632 was produced at Yuma, Arizona, from the selected 1000 heads. The 1000 single head rows were rogued for off types, retained rows were harvested in bulk to constitute the breeder seed.
Summer 2003:	Foundation seed of Aquila (UT97B 1480-1632) was produced at Cache Junction, Utah from Breeder seed produced in winter of 2003.
Summer 2004:	Registered seed of Aquila was produced.

Summer 2005: Certified Seed of Aquila was produced to be marketed for commercial production.

Aquila has been observed to be stable for 6 generations (beginning with the F_6 head row from which it originated in 1998, through the F_{11} Foundation field produced in 2003). There have been no variants observed. Any questionable plants rogued from Breeder and Foundation plantings were likely due to environmental variations. They were removed strictly as a precautionary measure.

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Exhibit B – Novelty Statement for Aquila

Aquila (a six-rowed type) mostly nearly resembles Millennium and Steptoe barleys. Differences between Aquila and the other two varieties include, but are not restricted to, the following characteristics:

1. Head shape of Aquila slightly tapered like Steptoe, while Millennium is a tapered head shape.

2. Head density of Aquila [Lax (Not dense), (2.9-3.1 mm/internode)] is similar to that of Millennium [Erect (Not dense), (2.4-2.7 mm/internode)], and more dense than Steptoe [Lax (3.2-3.5 mm/internode)].

3. Aquila has no overlapping of upper lateral spikelets, while Millennium and Steptoe has some overlap of lateral kernels at the tip of the head.

4. Aquila, Millennium, and Steptoe all have rachis edge covers with hairs.

5. Aquila, Millennium, and Steptoe all have glume awns longer than the glumes.

6. Aquila is covered with short hairs on the ventral surface of the glumes, while Millennium has more visible hairs on the ventral surface of the glumes than Aquila, and Steptoe is covered with hairs on the ventral surface of the glumes.

7. The lemma base shape of Aquila has a depression as in Millenium whereas Steptoe has a transverse crease.

On exhibit D, we present additional genotyping of Aquila with 32 barley microsatellites or SSR markers. We found polymorphism between Aquila *vs* Millenium or Steptoe for fourteen SSR markers covering all seven chromosomes of barley.

U.S. DEPARTMENT OF AGRICULTURE
AGRICULTURAL MARKETING SERVICE
SCIENCE AND TECHNOLOGY
PLANT VARIETY PROTECTION OFFICE
BELTSVILLE, MD 20705

OBJECTIVE DESCRIPTION OF VARIETY
Barley *(Hordeum vulgare* L.)

NAME OF APPLICANT (S)	TEMPORARY OR EXPERIMENTAL DESIGNATION	VARIETY NAME
Utah Agricultural Experiment Station	UT97B1480-1632	Aquila

ADDRESS *(Street and No. or RD No., City, State, Zip Code, and Country)*

Utah State University
4820 Old Main Hill
Logan, UT 84322

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PVPO NUMBER

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PLEASE READ ALL INSTRUCTIONS CAREFULLY:

Place the appropriate number that describes the varietal character of this variety in the boxes below. Place a zero in the first box (i.e., [0][9][9] or [0][9]) when the number is either 99 or less or 9 or less.

1. GROWTH HABIT:

[1] 1 = Spring 2 = Facultative Winter 3 = Winter Early Growth: [3] 1 = Prostrate 2 = Semi-Prostrate 3 = Erect

2. MATURITY: (50% Flowering)

[2] 1 = Early (California Mariout) 2 = Mid-Season (Betzes) 3 = Late (Frontier)

[3][ ][ ] No. Days Earlier Than Steptoe *

Same as Check N/A *

[ ][ ][ ] No. of Days Later Than N/A *

3. PLANT: (From Soil Level to Top of Head)

[3] 1 = Semi-Dwarf 2 = Short (California Mariout) 3 = Medium Tall (Betzes) 4 = Tall (Conquest)

[ ] cm Shorter Than N/A *

Same as Check _____ *

[8] cm Taller Than Millenium *

4. STEM:

[3] Exsertion (Flag to Spike at Maturity): 1 = (0 – 3 cm) 2 = (3 – 10 cm) 3 = (10 – 15 cm)

[2] Anthocyanin: 1 = Absent 2 = Present

[05][ ] No. of Nodes (Originating from Node Above Ground)

[4] Collar Shape: 1 = Closed 2 = V-Shaped 3 = Open 4 = Modified Closed or Open

[1] Shape of Neck: 1 = Straight 2 = Snaky 3 = Other (Specify) _____

* A commercial variety grown in the same trial.

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5. LEAF:

[1] Basal Leaf Sheath (Seedling): 1 = Glabrous 2 = Pubescent

[2] Position of Flag Leaf (At Boot Stage): 1 = Drooping 2 = Upright

[2] Waxiness: 1 = Absent (Glossy) 2 = Slightly Waxy 3 = Waxy

[015] mm Width (First Leaf Below Flag Leaf)

[17.5] cm Length (First Leaf Below Flag Leaf)

[1] Anthocyanin in Leaf Sheath: 1 = Absent 2 = Present

6. HEAD:

[2] Type: 1 = Two-Rowed 2 = Six-Rowed

[2] Density: 1 = Lax 2 = Erect (Not Dense) 3 = Erect (Dense) 4 = Other (Specify) _____

[2] Shape: 1 = Tapering 2 Strap 3 = Clavate 4 = Other (Specify) _____ MAH 10-5-2006

[2] Waxiness 1 = Absent (Glossy) 2 = Slightly Waxy 3 = Waxy

[3] Lateral Kernels Overlap: 1 = None 2 = At Tip 3 = 1/4 – 1/2 of Head

[2] Rachis (Hair on Edge): 1 = Lacking 2 = Few 3 = Covered

7. GLUME:

[3] Length: 1 = 1/3 of Lemma 2 = 1/2 of Lemma 3 = More than 1/2 of Lemma

[2] Hairs: 1 = None 2 = Short 3 = Long

[4] Hair Covering: 1 = None 2 = Restricted to Middle 3 = Confined to Band 4 = Completely Covered

[3] Awns: 1 = Less than Equal to Length of Glumes 2 = Equal to Length of Glumes 3 = More than Equal to Length of Glumes

[2] Awn Surface: 1 = Smooth
2 = Semi-Smooth
3 = Rough

8. LEMMA:

[5] Awn: 1 = Awnless
2 = Awnlets on Central Rows, Awnless on Lateral Rows
3 = Short on Central Rows, Awnlets on Lateral Rows
4 = Short (Less than Equal to Length of Spike)
5 = Long (Longer than Spike)
6 = Hooded

[4] Awn Surface: 1 = Awnless 2 = Smooth 3 = Semi-Smooth 4 = Rough

[2] Teeth: 1 = Absent 2 = Few 3 = Numerous

[1] Hair: 1 = Absent 2 = Present

[1] Shape of Base: 1 = Depression 2 = Slight Crease 3 = Transverse Crease

[1] Raachilla Hairs: 1 = Short 2 = Long

9. STIGMA:

[1] Hairs: 1 = Few 2 = Many

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10. SEED:

[2] Type: 1 = Naked 2 = Covered

[1] Hairs on Ventral Furrow: 1 = Absent 2 = Present

[5] Length:
1 = Short (8.0 mm)
2 = Short to Mid-long (7.5 – 9.0 mm)
3 = Mid-long (8.5 – 9.5 mm)
4 = Mid-long to Long (9.0 – 10.5 mm)
5 = Long (10.0 mm)

[3] Wrinkling of Hull: 1 = Naked 2 = Slightly Wrinkled 3 = Semi-Wrinkled 4 = Wrinkled

[1] Aleurone Color: 1 = Colorless (White or Yellow) 2 = Blue

[3][ ] Percent Abortive [40][7] GMS. per 1000 Seeds

11. DISEASE: (0 = Not Tested, 1 = Susceptible, 2 = Resistant, 3 = Intermediate, 4 - Tolerant)

[0]	Septoria	[0]	Net Blotch	[0]	Spot Blotch	[0]	Powdery Mildew
[3]	Loose Smut	[0]	Bacterial Blight	[0]	Covered Smut	[0]	False Loose Smut
[0]	Stem Rust	[0]	Leaf Rust	[0]	Scab	[0]	Scald
[0]	Aster Yellows Virus	[0]	BSMV	[0]	BYDV	[ ]	Other (Specify) _____

12. INSECT: (0 = Not Tested, 1 = Susceptible, 2 = Resistant, 3 = Intermediate, 4 - Tolerant)

[0]	Green Bug	[0]	English Grain Aphid	[0]	Chinch Bug	[0]	Armyworm
[0]	Grasshoppers	[1]	Cerial Leaf Beetle	[ ]	Other (Specify) _____		

Hessian Fly Races: [0] GP [0] A [0] B [0] C [ ] Other Specify)_____ [0] D [0] E [0] F [0] G

13. CHEMICAL: (0 = Not Tested, 1 = Susceptible, 2 = Resistant, 3 = Intermediate, 4 = Tolerant)

[0] DDT [ ] Other (Specify) _____

14. INDICATE WHICH VAREITY MOST CLOSELY RESEMBLES THAT SUBMITTED:

CHARACTER	NAME OF VARIETY	CHARACTER	NAME OF VARIETY
Plant Tillering	Millennium	Seed Size	Baronesse
Leaf Size	Steptoe	Coleoptile Elongation	Steptoe
Leaf Color	Millennium	Seedling Pigmentation	Steptoe
Leaf Carriage	Steptoe		

REFERENCES:

The following publications may be used as a reference aid for the standardization of character descriptions and terms used in this form:

1. Wiebe, G.A., and D.A. Reid, 1961, Classifications of Barley Varieties Grown in the United States and Canada in 1958, Technical Bulletin No. 1224, U.S. Department of Agriculture.
2. Reid, D.A., and G.A. Wiebe, 1968, Barley: Origin, Botany, Culture, Winter Hardiness, Genetics, Utilization, Pests, Agriculture Handbook No. 338, U.S. Department of Agriculture, pp. 61-84.
3. Malting Barley Improvement Association, Milwaukee, Wisconsin, 1971, Barley Variety Dictionary.

COLOR: Nickerson's or any recognized color fan may be used to determine color of the described variety.

Exhibit D: Additional genotyping of Aquila barley

Materials and Methods

These molecular experiments were conducted by Dr. Shiaoman Chao at the USDA-ARS Biosciences Research Lab in Fargo (SD). In these experiments we surveyed a set of 32 barley microsatellites or SSR markers (Ramsay, et al., 2000). We will give results for fourteen of these SSR markers that were found to be polymorphic between Aquila and Millennium and Steptoe barley genotypes. Their respective sequences are presented in Table I. We employed fluorescent-based genotyping technology using a semi-automated capillary gel system, ABI3130xl, from Applied Biosystems.

PCR reactions

The PCR reaction setup was based on the M13-tailed PCR method (Boutin-Ganache, et al, 2001) after optimization. The forward primers were modified by adding 19 bases of M13 derived sequence to their 5'end. The 19-base M13 primer was labeled with one of the four fluorescent dyes, FAM, VIC, NED and PET. For PCR reactions, 50ng of DNA template was used along with a modified forward primer, reverse primer and M13 primer labeled with one dye added at a molar ratio of 0.15:1:1. The total reaction volume was 10 microliters. The cycling condition used was based on published results for particular SSRs (Ramsay, et al., 2000).

Gel Electrophoresis and fragment analysis

The PCR products labeled with four different fluorescent dyes were pooled. The pooled samples were subjected to gel electrophoresis after adding the size standards. The gel electrophoresis was carried out on the ABI3130xl sequencer, a 16-capillary gel system. Fragment sizing and allele calling were performed using the GeneMapper v3.7 software from Applied Biosystems. The fragment size call is based on the Local Southern algorithm.

Results

We present fluorescent profiles for Aquila, Millennium and Steptoe that were generated with fourteen sets of SSR-primers (Figures 1-14). We found polymorphism for all seven chromosomes of barley.
On chromosome 1 (chr 1), with the WMC1E8 marker (Fig. 1), we found DNA fragment sizes of 253 base pairs (bp) for Aquila, and 208 bp for Millennium and Steptoe.
On chr 2, all three lines differ in fragment sizes generated with marker Bmac0134 (Fig. 2) (142 bp for Aquila, 139 bp for Millennium, 166 bp for Steptoe) and Bmag0125 (Fig.3) (154 bp for Aquila, 160 bp for Millennium, 152 bp for Steptoe).
On chr 3, we found polymorphism with four SSR markers. In all four cases the allele found in Aquila was different from the one shared by Millennium and Steptoe; for

Bmag0136 (Fig. 4), 220 bp *vs* 218 bp, for Bmac0209 (Fig.5), 206 *vs* 195 bp, for Bmag0013 (Fig.6), 179 *vs* 173 bp, and for Bmag0877 (Fig.7), 169 *vs* 165 bp.
On chr 4, we found polymorphism for three SSR markers. For Bmac0310 (Fig.8), the allele size is 192 bp for Aquila and 159 bp for both Millennium and Steptoe. For EBmac0701 (Fig.9), the allele size of Aquila (166bp) differs from those of Millennium (160 bp) and Steptoe (152 bp). Finally, for EBmac0788 (Fig.10), Aquila has an allele size of 192 bp as Millennium and Steptoe have allele sizes of 185 and 178 bp, respectively.
On chr 5, for the Bmag0337 marker (Fig. 11), the allele size for Aquila is 163 bp as that of Millennium and Steptoe is 167 bp.
On chr 6, we found two polymorphic SSR markers. For Bmag0496 (Fig. 12), the allele size for Aquila is 213 bp as those of Millennium and Steptoe are 209 and 205 bp, respectively. For EBmac0806 (Fig. 13), we found an identical allele size for Millennium and Steptoe (178 bp) as that of Aquila was slightly larger (186 bp).
Finally on chr 7, for the Bmag0120 marker (Fig. 14), we found that the allele for Aquila was slightly smaller than that shared by Millennium and Steptoe (248 *vs* 250 bp)

References

Boutin-Ganache, I., M. Raposo, M. Raymond and C.F. Deschepper (2001). M13-tailed primers improve the readability and usability of microsatellite analysis performed with two different allele-sizing methods. *BioTechniques* 31(1):25-28.

Ramsay, L., M. Macaulay, S. degli Ivanissevich, K. MacLean, L. Cradle, J. Fuller, K.J. Edwards, S. Tuvesson, M. Morgante, A. Massari, E. Maestri, N. Marmiroli, T. Sjakste, M. Ganal, W. Powell and R. Waugh (2002). A simple sequence repeat-based linkage map of barley. *Genetics* 156:1997-2005.

Table 1: Microsatellite markers utilized in the genotyping of Aquila, Millenium and Steptoe barley lines.
SSR abbrevations, chromosome assignment, genetic map location and sequences for forward and reverse primers are indicated.

SSR	chr.	Map location (cM)	Repeat motif	Forward	Reverse
WMC1E8	1	164	(AC)24	TCATTCGTTGCAGATACACCAC	TCAATGCCCTTGTTTCTGACCT
Bmac0134	2	5	(AC)28	CCAACTGAGTCGATCTCG	CTTCGTTGCTTCTCTACCTT
Bmag0125	2	63	(AG)19	AATTAGCGAGAACAAAATCAC	AGATAACGATGCACCACC
Bmag0877	3	141	(GA)15	AAAGCTCATGGTAGATCAAGA	TAGTTTTCCCAAAAGCTTCTA
Bmac0209	3	55	(AC)13	CTAGCAACTTCCCAACCGAC	ATGCCTGTGTGTGGACCAT
Bmag0013	3	141	(CT)21	AAGGGGAATCAAAATGGGAG	TCGAATAGGTCTCCGAAGAAA
Bmag0136	3	50	(AG)6-(AG)10-(AG)6	GTACGCTTTCAAACCTGG	GTAGGAGGAAGAATAAGGAGG
Bmac0310	4	43	(CT)11(AC)20	CTACCTCTGAGATATCATGCC	ATCTAGTGTGTGTTGCTTCCT
EBmac0701	4	76	(AC)23	ATGATGAGAACTCTTCACCC	TGGCACTAAAGCAAAAGAC
EBmac0788	4	90	(TG)23	TAACTTACTTTATATCCATGGCA	ATGATGAGAACTCTTCACCC
Bmag0337	5	35	(AG)22	ACAAAGAGGGAGTAGTACGC	GACCCATGATATATGAAGATCA
Bmag0496	6	96	(CT)20	AGTATAACCAACAGCCGTCTA	CTATAGCACGCCTTTGAGA
EBmac0806	6	119	(CA)4GA(CA)8,(CA)5	ACTAAGTCCTTTCACGAGGA	GTGTGTAGTAGGTGGGTACTTG
Bmag0120	7	118	(AG)15	ATTTCATCCCAAAGGAGAC	GTCACATAGACAGTTGTCTTCC

Figure 1: Results of gel electrophoresis and fragment analysis with SSR marker WMC1E8 for Aquila, Millenium and Steptoe barley genotypes.

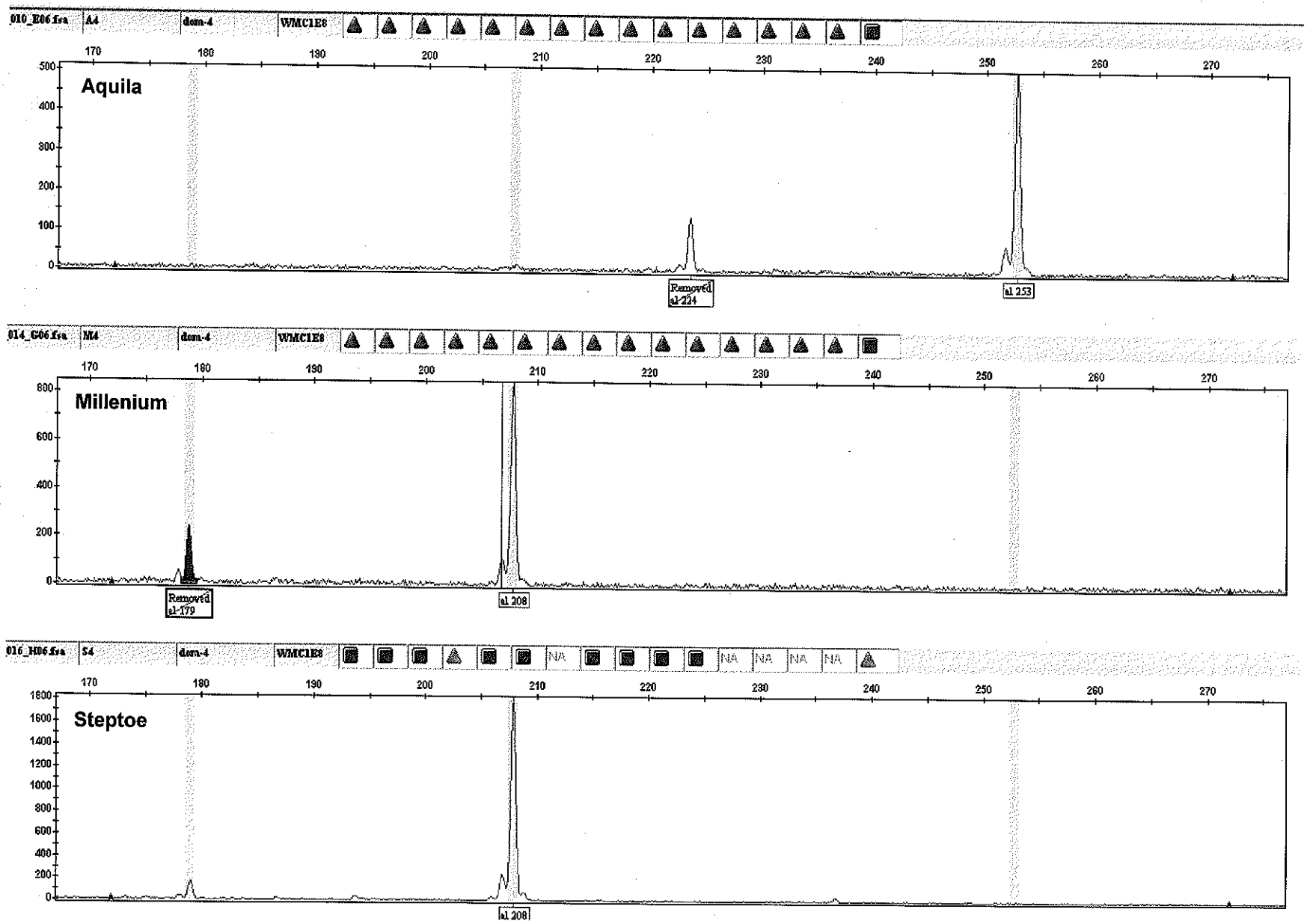


Figure 2: Results of gel electrophoresis and fragment analysis with SSR marker Bmac0134 for Aquila, Millenium and Steptoe barley genotypes.

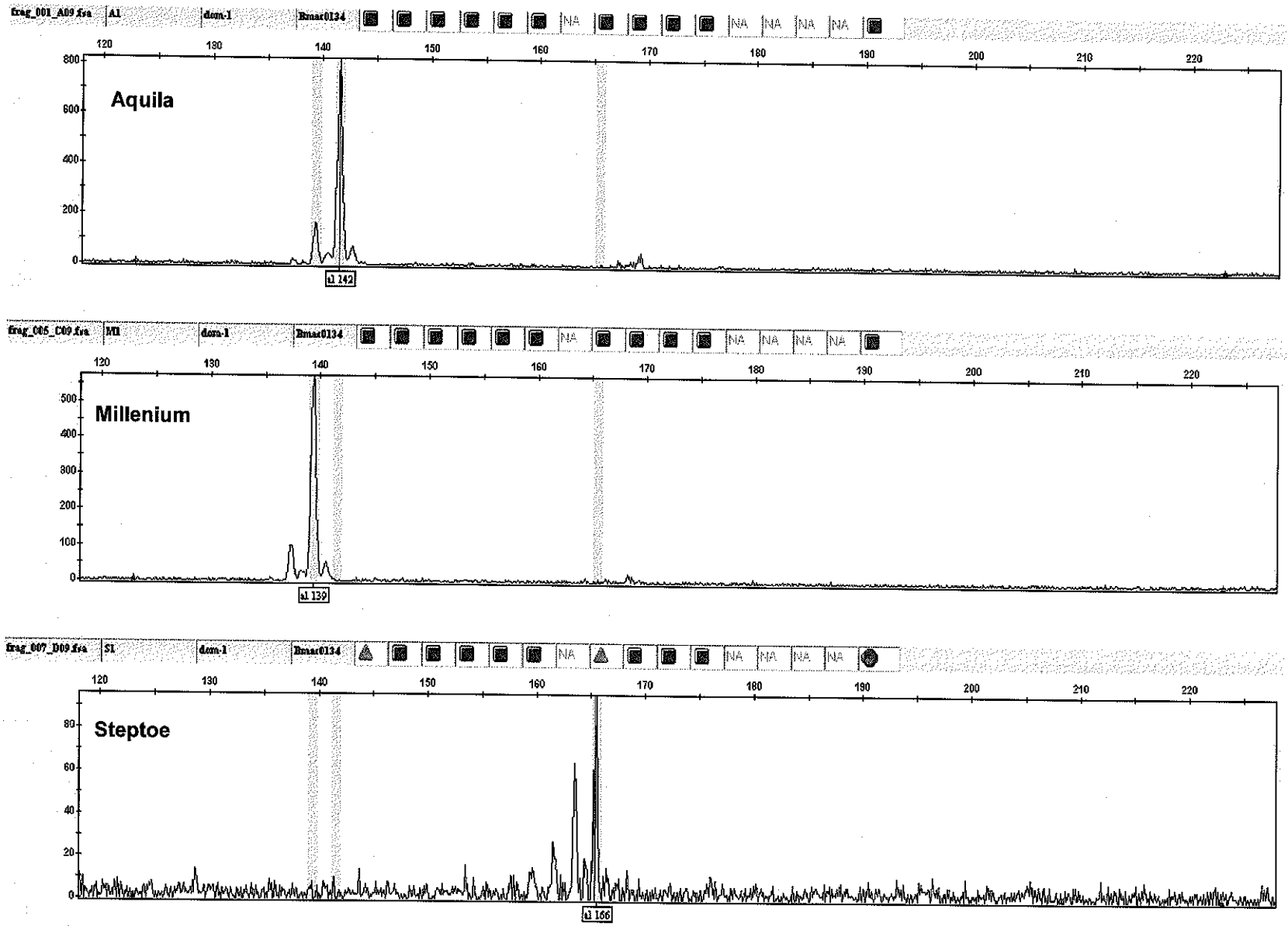


Figure 3: Results of gel electrophoresis and fragment analysis with SSR marker Bmag0125 for Aquila, Millenium and Steptoe barley genotypes.

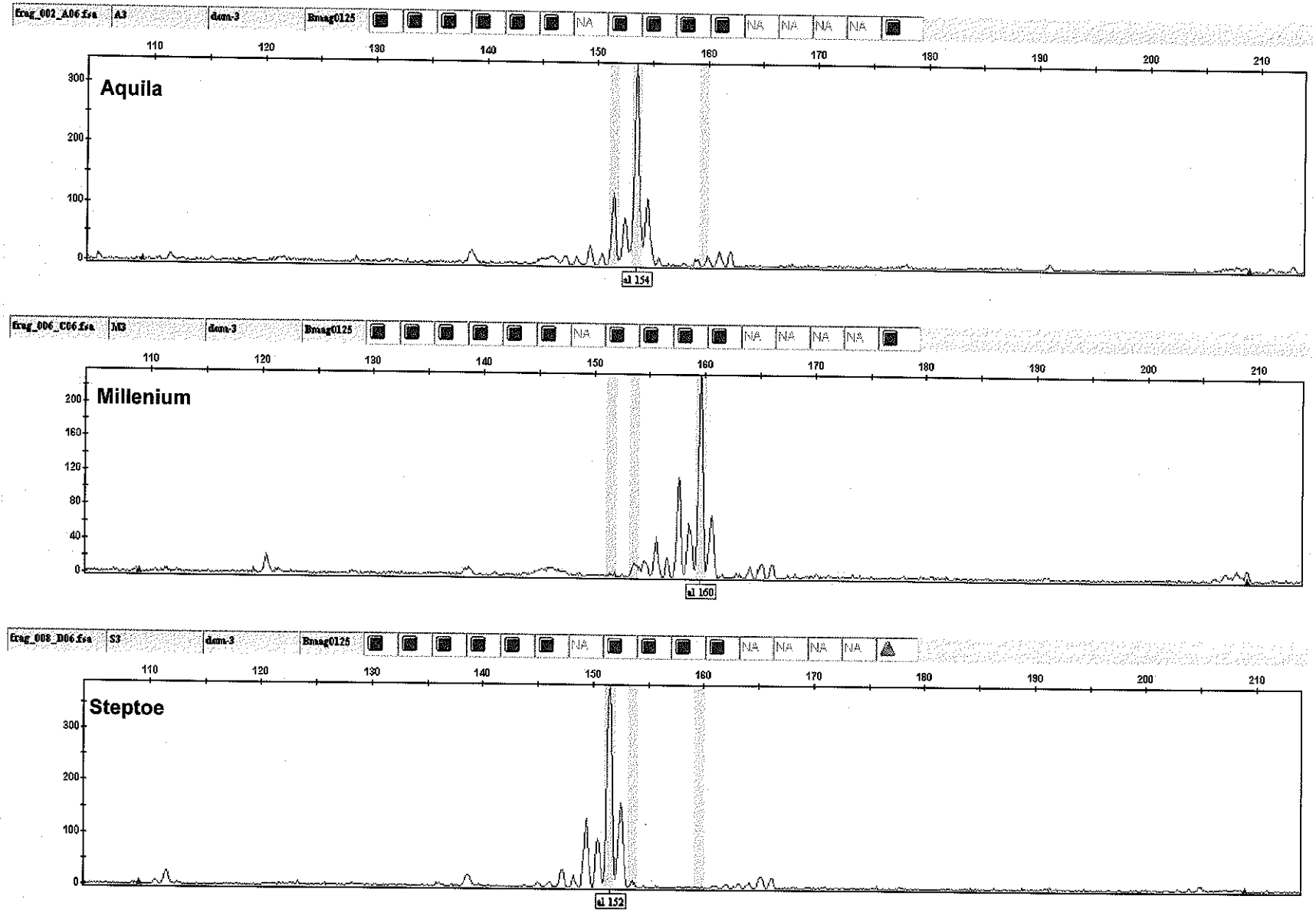


Figure 4: Results of gel electrophoresis and fragment analysis with SSR marker Bmag0136 for Aquila, Millenium and Steptoe barley genotypes.

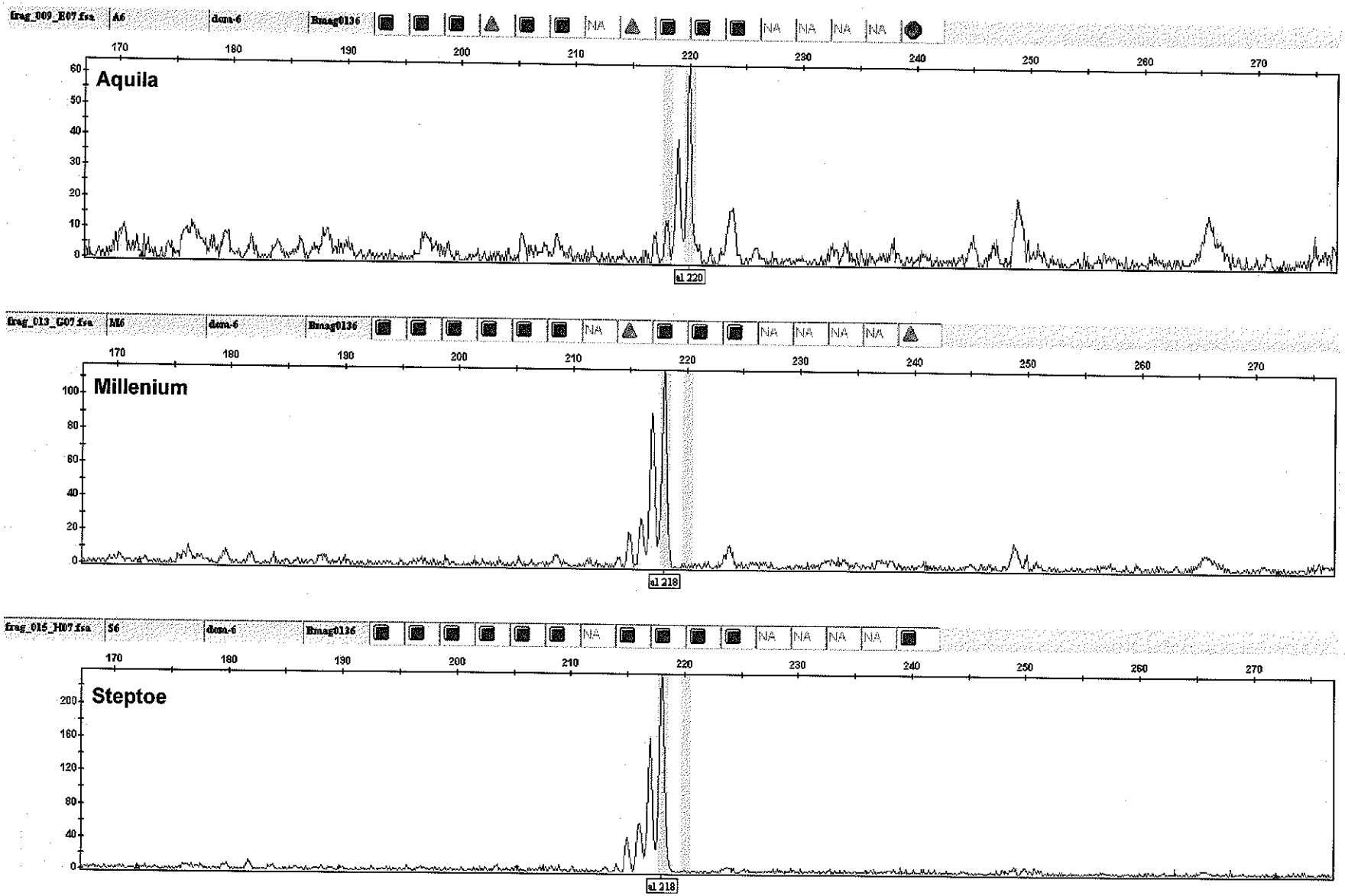


Figure 5: Results of gel electrophoresis and fragment analysis with SSR marker Bmac0209 for Aquila, Millenium and Steptoe barley genotypes.

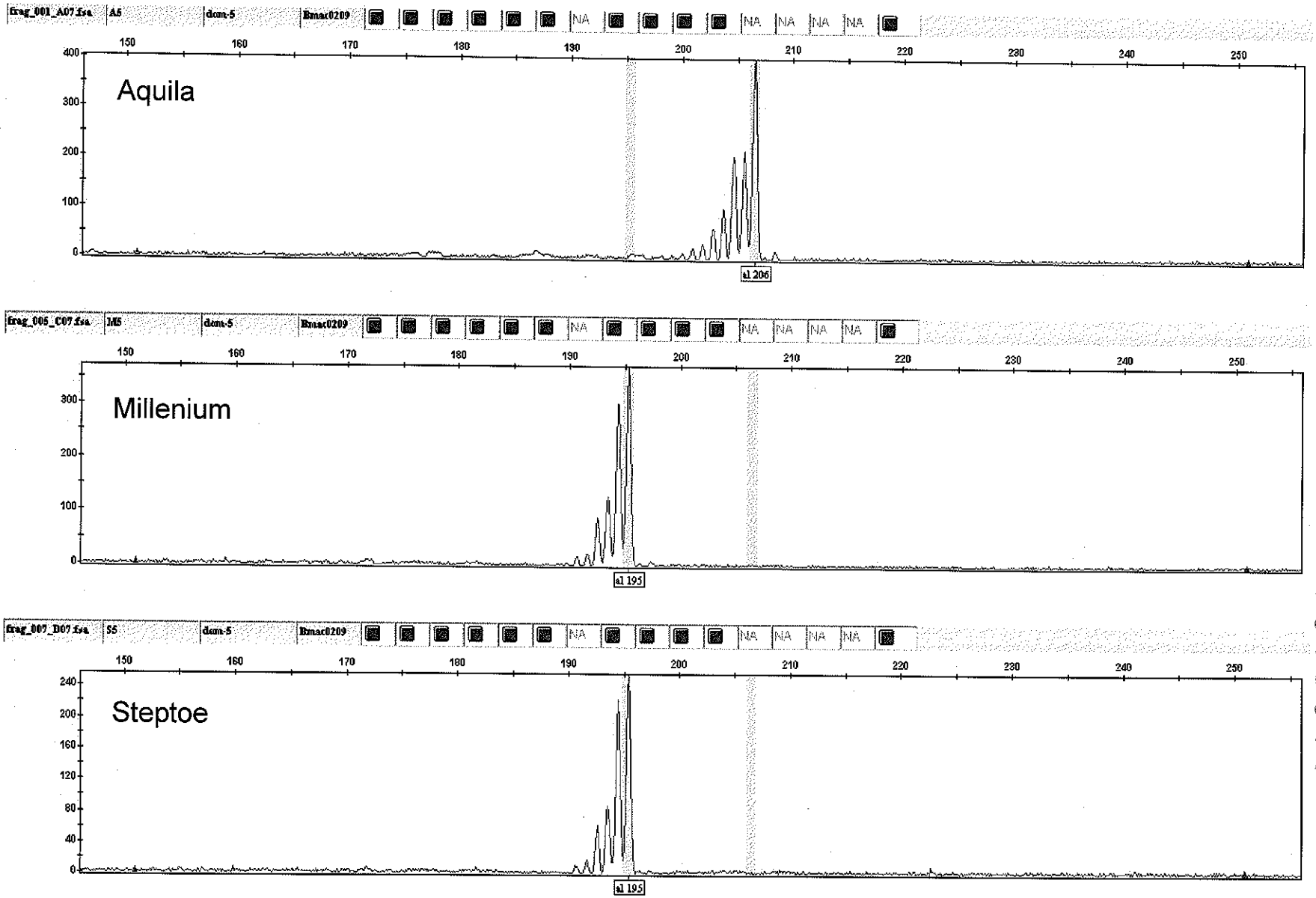


Figure 6: Results of gel electrophoresis and fragment analysis with SSR marker Bmag0013 for Aquila, Millenium and Steptoe barley genotypes.

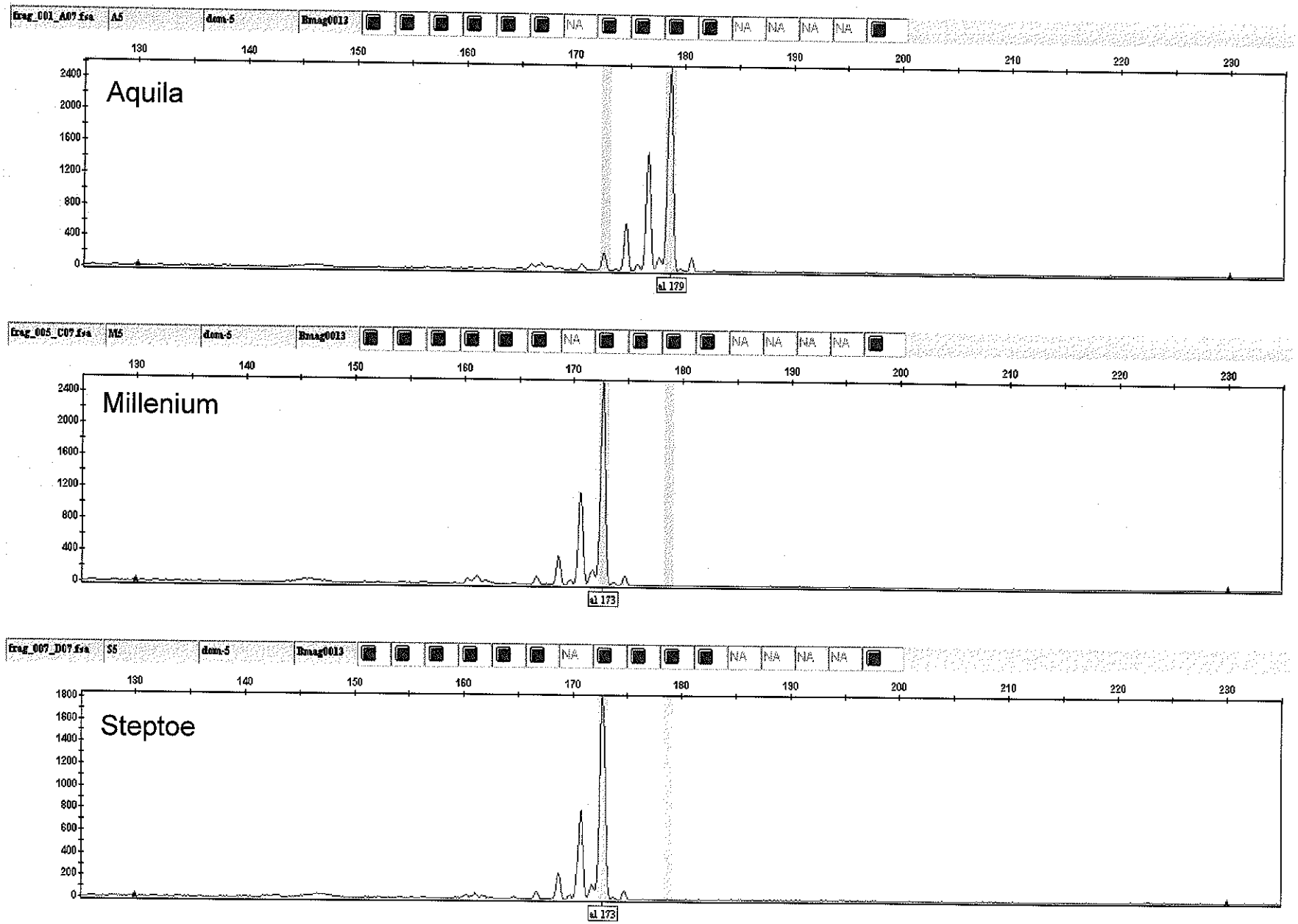


Figure 7: Results of gel electrophoresis and fragment analysis with SSR marker Bmag0877 for Aquila, Millenium and Steptoe barley genotypes.

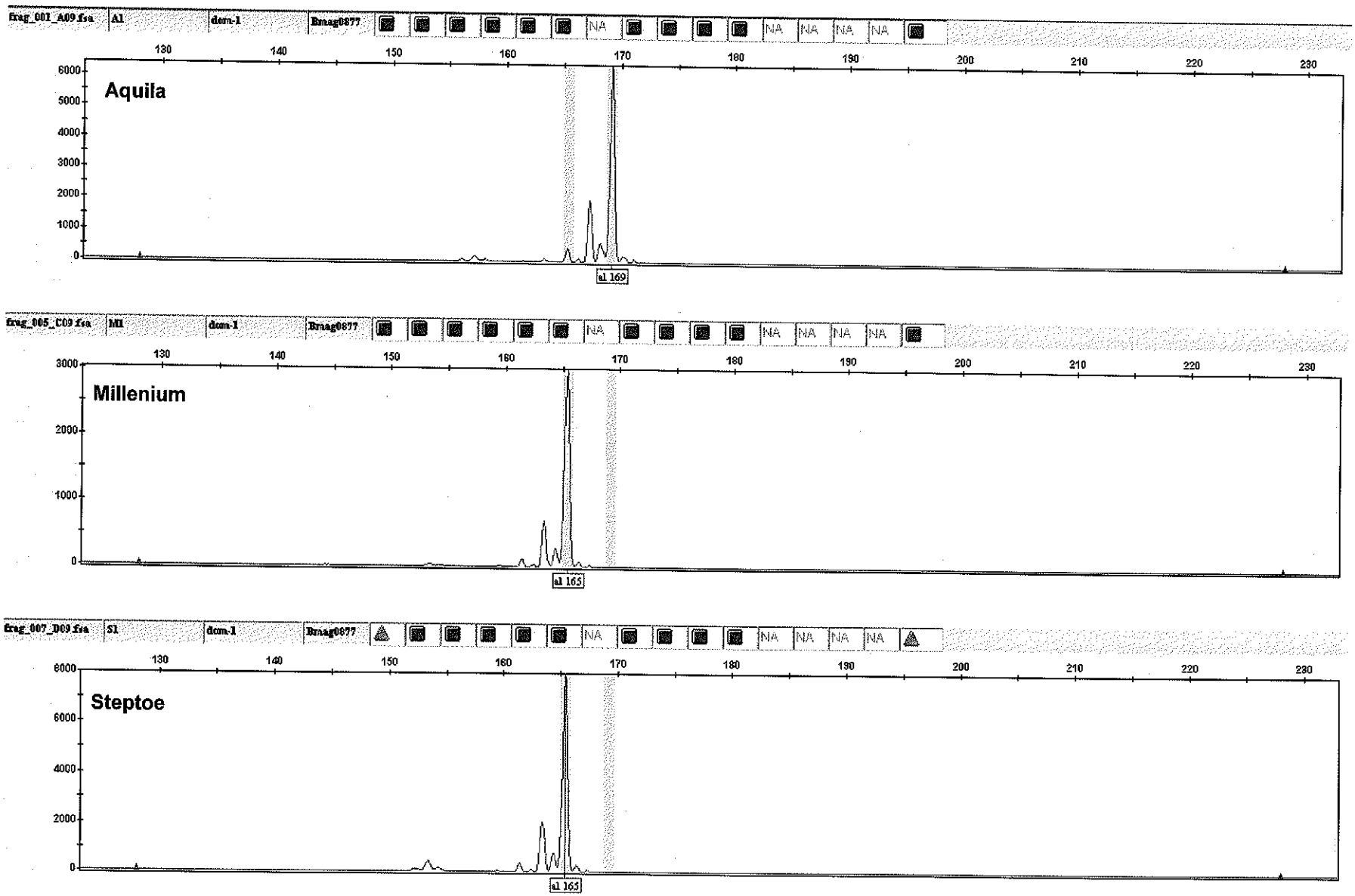


Figure 8: Results of gel electrophoresis and fragment analysis with SSR marker Bmac0310 for Aquila, Millenium and Steptoe barley genotypes.

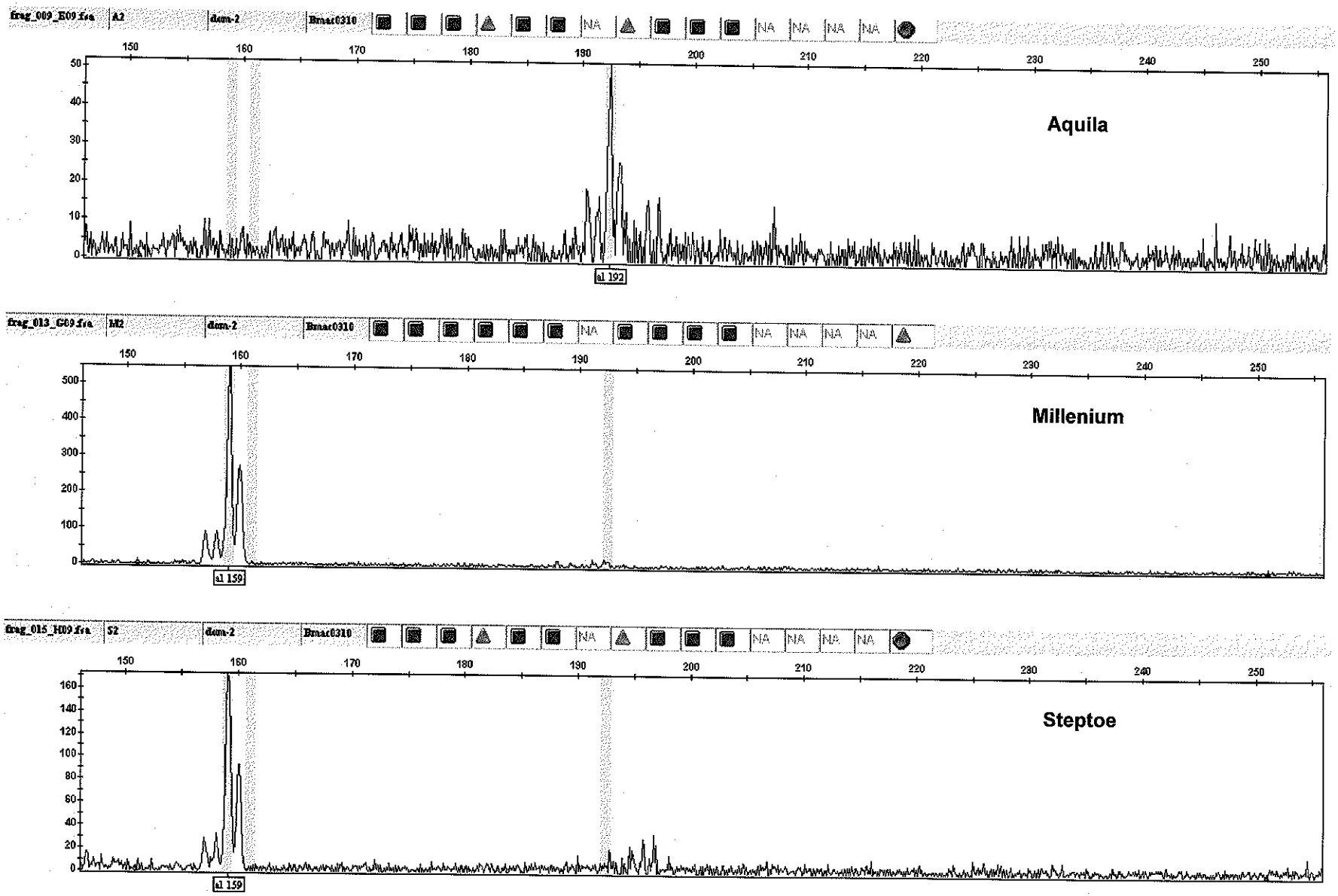


Figure 9: Results of gel electrophoresis and fragment analysis with SSR marker EBmac0701 for Aquila, Millenium and Steptoe barley genotypes.

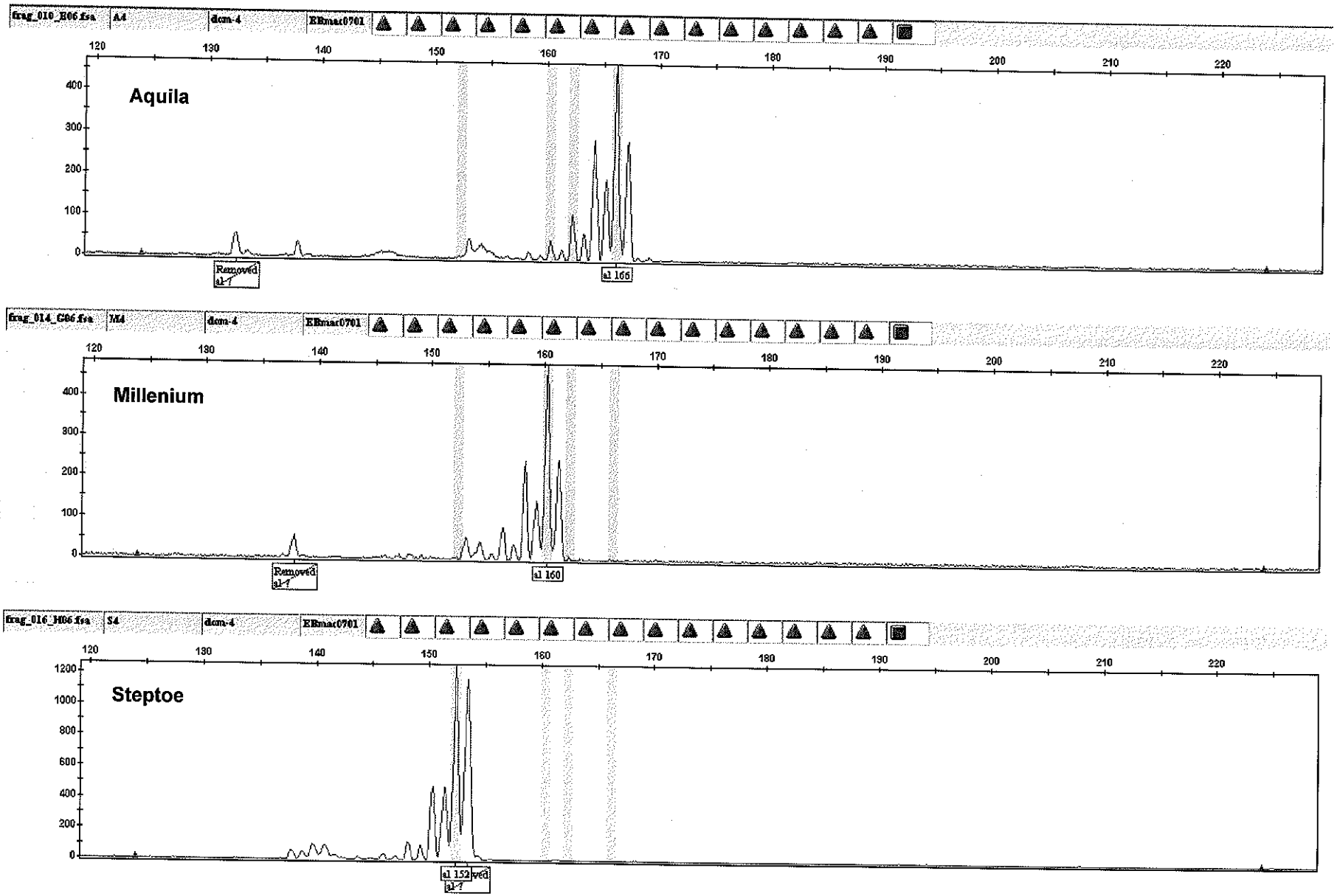


Figure 10: Results of gel electrophoresis and fragment analysis with SSR marker EBmac0788 for Aquila, Millenium and Steptoe barley genotypes.

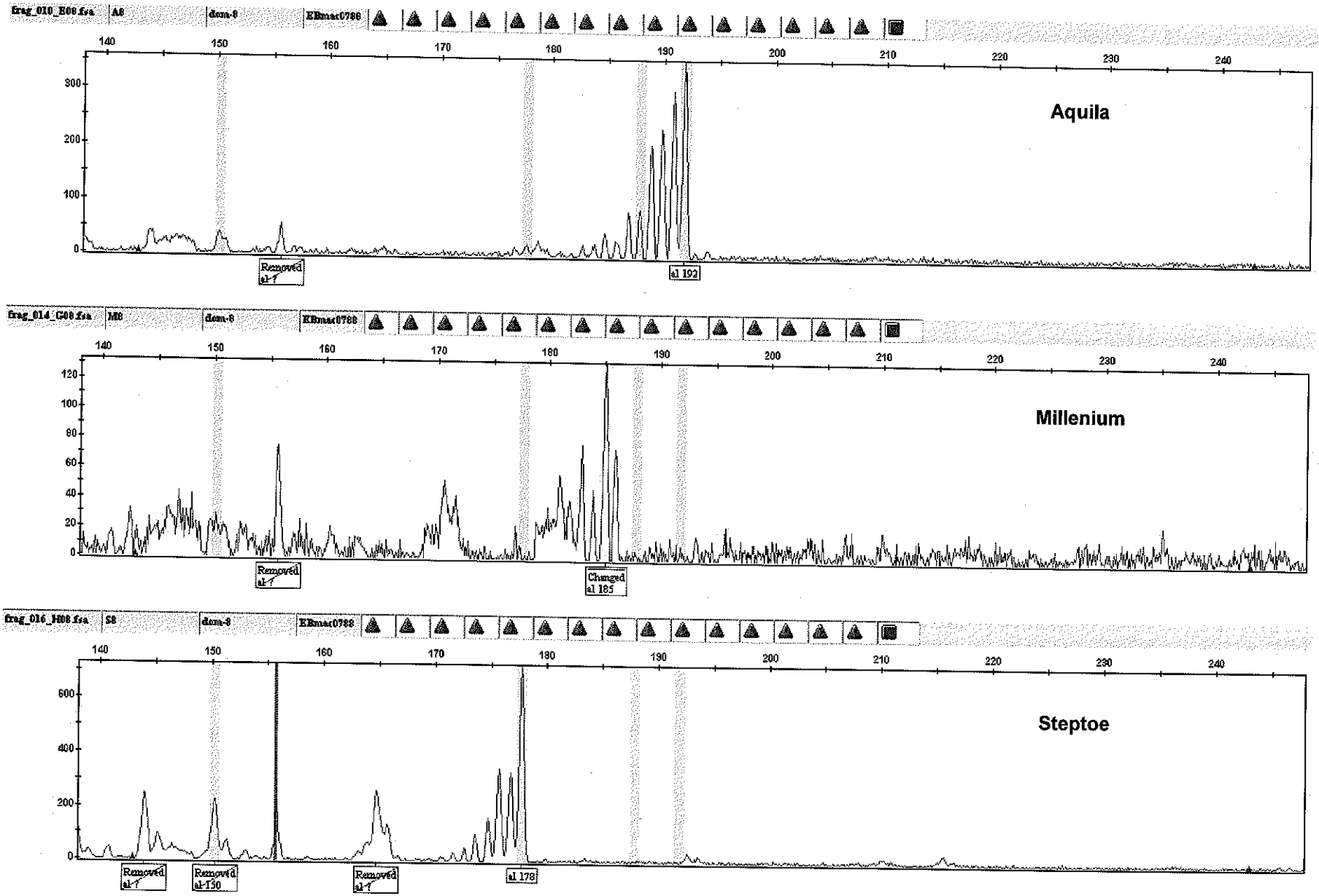


Figure 11: Results of gel electrophoresis and fragment analysis with SSR marker Bmag0337 for Aquila, Millenium and Steptoe barley genotypes.

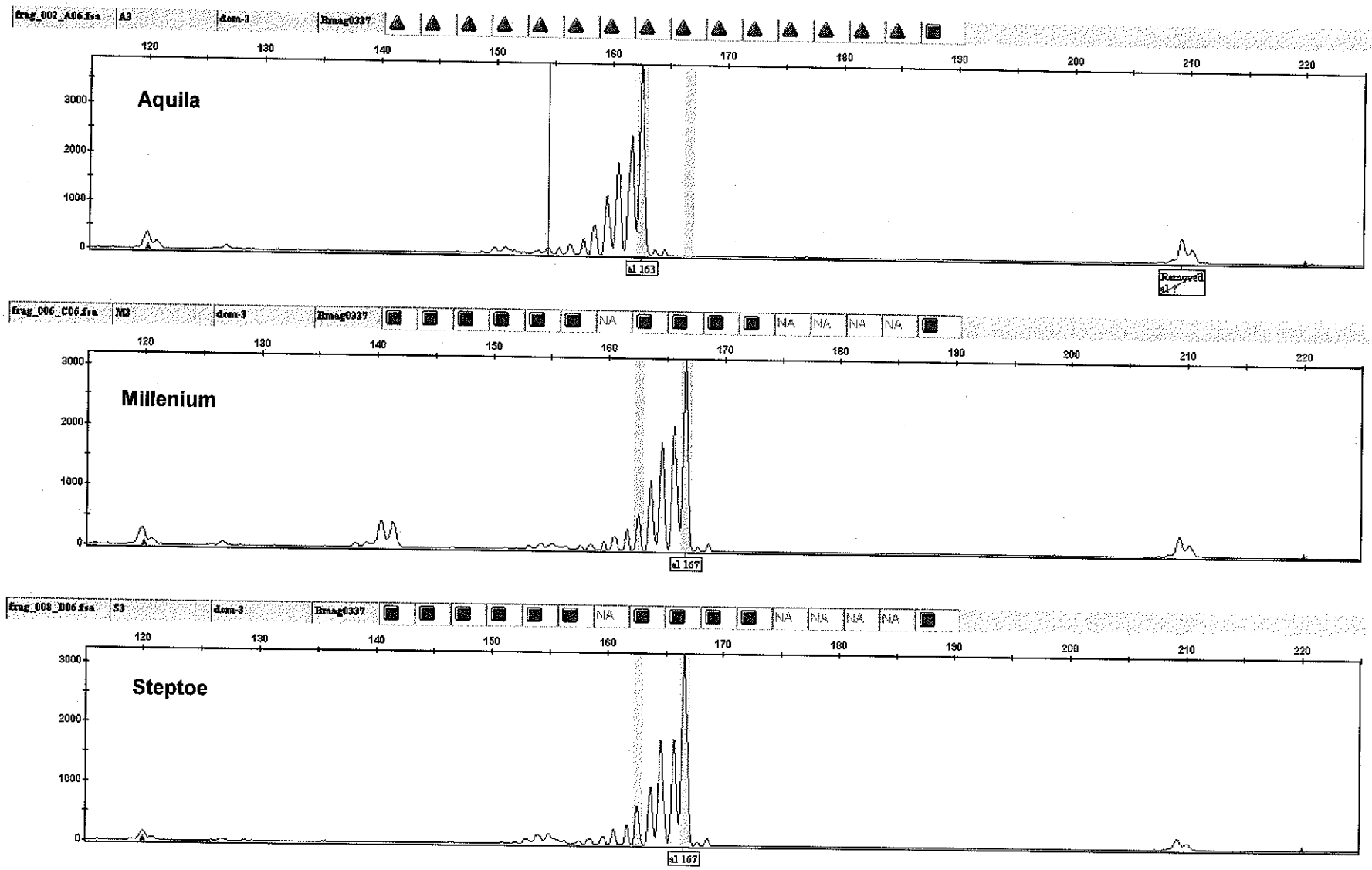


Figure 12: Results of gel electrophoresis and fragment analysis with SSR marker Bmag0496 for Aquila, Millenium and Steptoe barley genotypes.

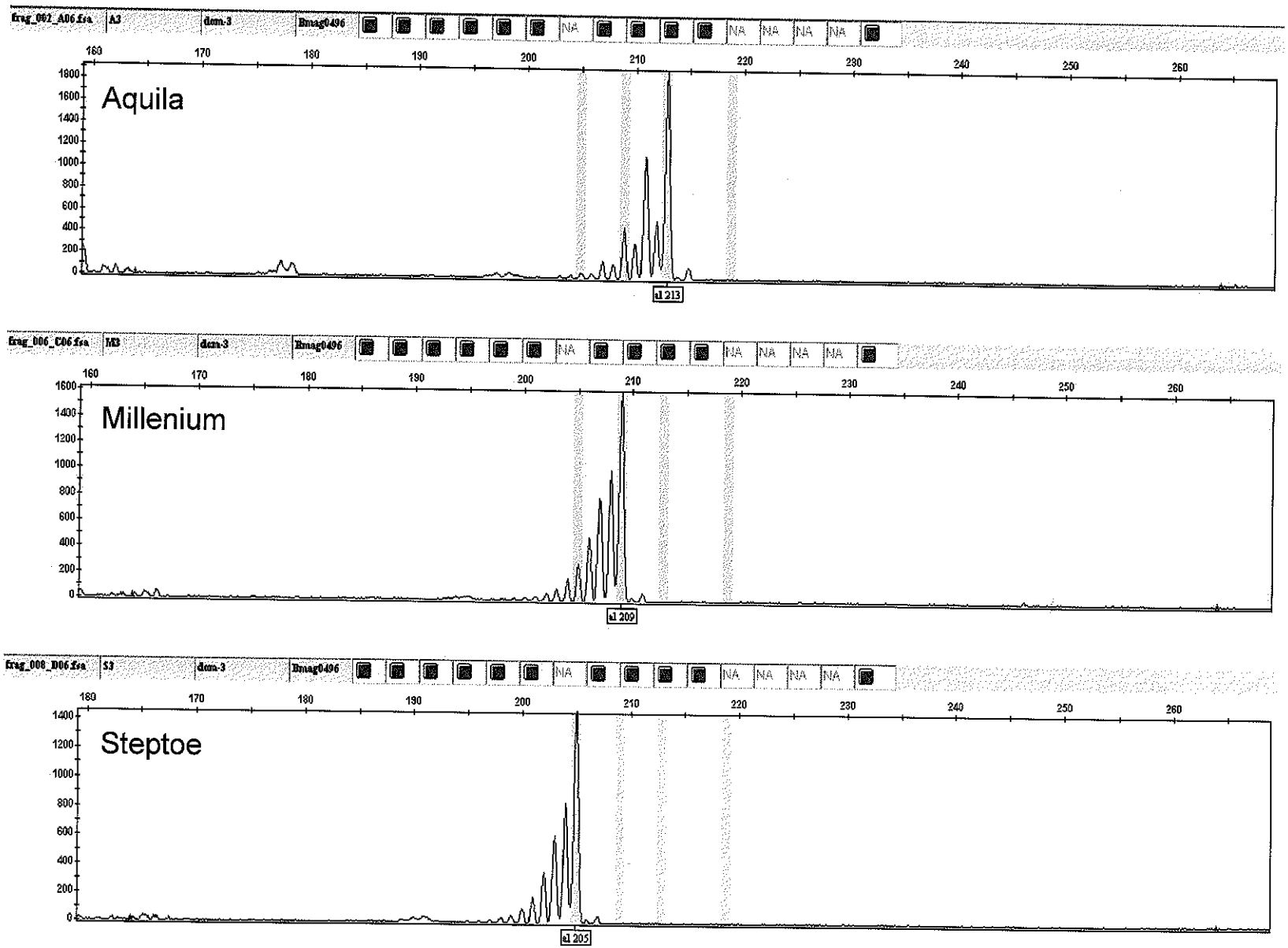


Figure 13: Results of gel electrophoresis and fragment analysis with SSR marker EBmac0806 for Aquila, Millenium and Steptoe barley genotypes.

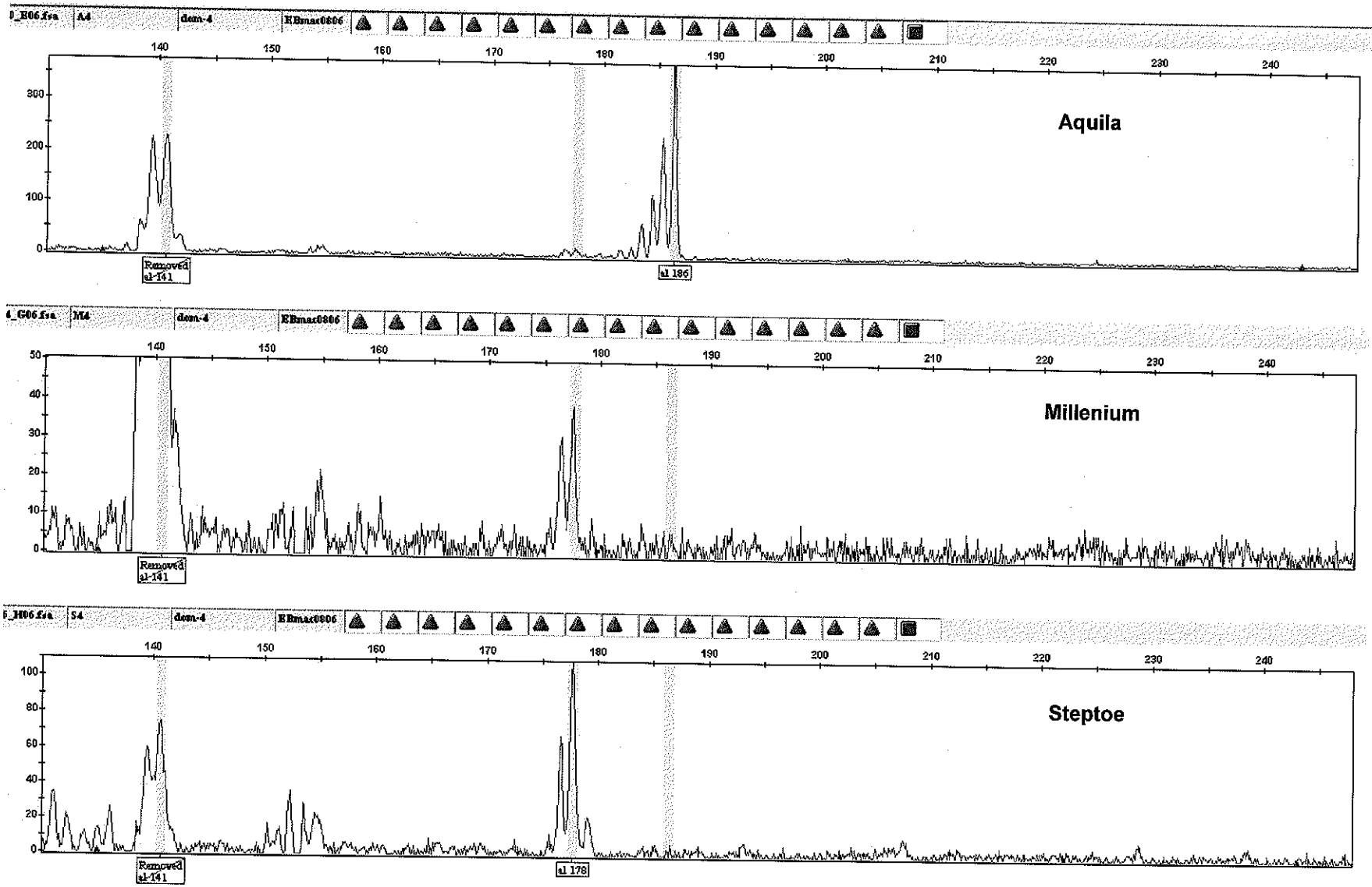
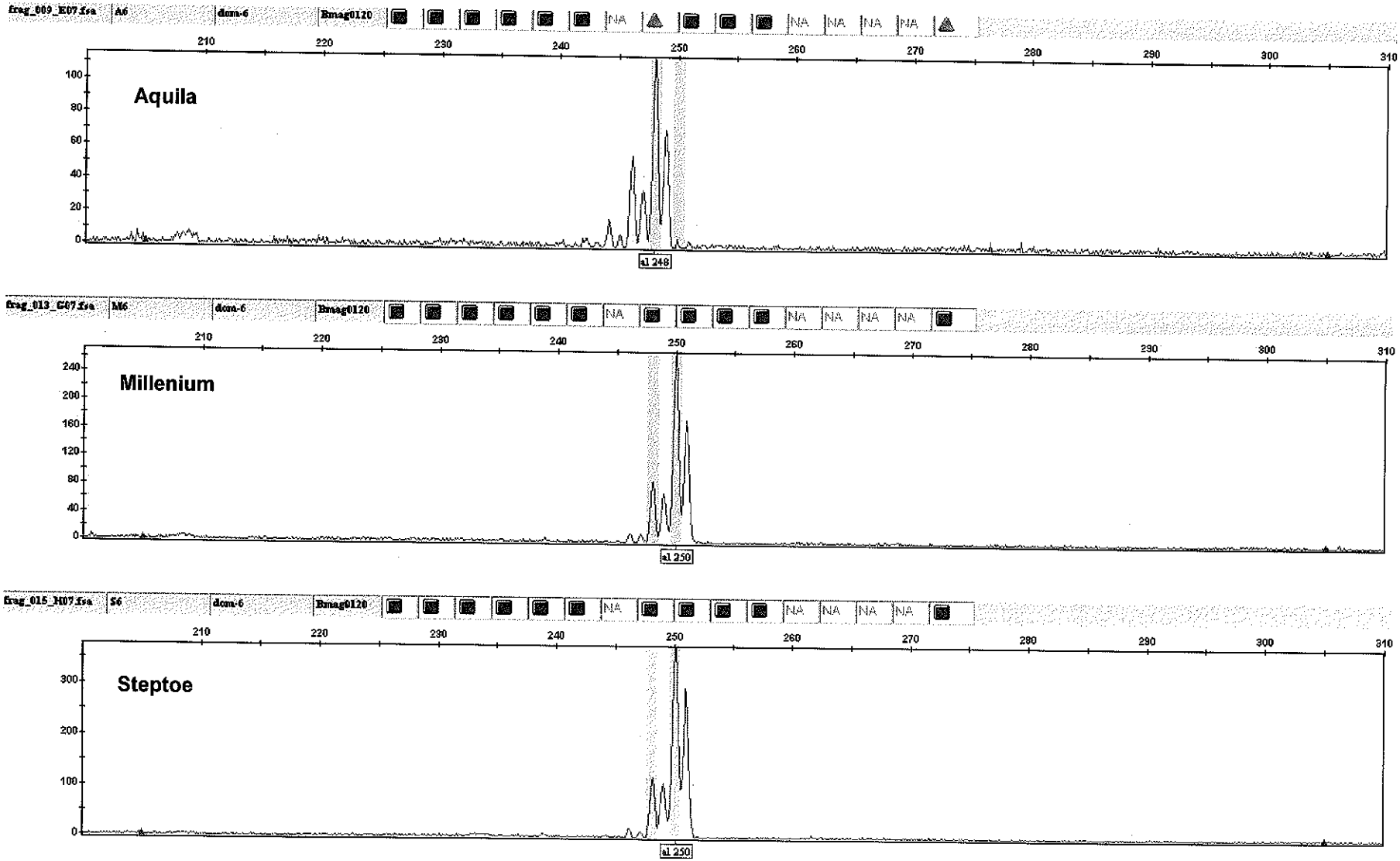


Figure 14: Results of gel electrophoresis and fragment analysis with SSR marker Bmag0120 for Aquila, Millenium and Steptoe barley genotypes.



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U.S. DEPARTMENT OF AGRICULTURE
AGRICULTURAL MARKETING SERVICE

EXHIBIT E
STATEMENT OF THE BASIS OF OWNERSHIP

Application is required in order to determine if a plant variety protection certificate is to be issued *(7 U.S.C. 2421)*. The information is held confidential until the certificate is issued *(7 U.S.C. 2426)*.

1. NAME OF APPLICANT(S)	2. TEMPORARY DESIGNATION OR EXPERIMENTAL NUMBER	3. VARIETY NAME
Utah State University	UT97B1480-1632	Aquila
4. ADDRESS *(Street and No., or R.F.D. No., City, State, and ZIP, and Country)*	**5. TELEPHONE** *(Include area code)*	**6. FAX** *(Include area code)*
4820 Old Main Hill Logan, UT 84322	(435) 797-7214	(435) 797-3376
	7. PVPO NUMBER 200600040	

8. Does the applicant own all rights to the variety? Mark an "X" in the appropriate block. **If no, please explain.** ☑ **YES** ☐ **NO**

9. Is the applicant (individual or company) a U.S. national or a U.S. based company? **If no, give name of country.** ☑ **YES** ☐ **NO**

10. Is the applicant the original owner? ☑ **YES** ☐ **NO** **If no, please answer one of the following:**

a. If the original rights to variety were owned by individual(s), is (are) the original owner(s) a U.S. National(s)?
☐ **YES** ☐ **NO** **If no, give name of country**

b. If the original rights to variety were owned by a company(ies), is (are) the original owner(s) a U.S. based company?
☐ **YES** ☐ **NO** **If no, give name of country**

11. Additional explanation on ownership *(Trace ownership from original breeder to current owner. Use the reverse for extra space if needed)*:

Aquila (UT97B1480-1632) was originated and preliminary developed by Dr. Rulon S. Albrechtsen and further developed and released by Dr. Dominique Roche, plant breeders at the Utah Agricultureal Experiment Station at Utah State University, Logan, Utah. By agreement between employee and the Utaha Agricultural Experiment Station and Utah State University, all rights to any invention, discovery or develoment made by an employee are assigned to the employer. No rights to such invention, discorvery, or development are retained by the employee.

PLEASE NOTE:

Plant variety protection can only be afforded to the owners (not licensees) who meet the following criteria:

1. If the rights to the variety are owned by the original breeder, that person must be a U.S. national, national of a UPOV member country, or national of a country which affords similar protection to nationals of the U.S. for the same genus and species.

2. If the rights to the variety are owned by the company which employed the original breeder(s), the company must be U.S. based, owned by nationals of a UPOV member country, or owned by nationals of a country which affords similar protection to nationals of the U.S. for the same genus and species.

3. If the applicant is an owner who is not the original owner, both the original owner and the applicant must meet one of the above criteria.

The original breeder/owner may be the individual or company who directed the final breeding. See Section 41(a)(2) of the Plant Variety Protection Act for definitions.

U.S. DEPARTMENT OF AGRICULTURE
AGRICULTURAL MARKETING SERVICE
SCIENCE AND TECHNOLOGY
PLANT VARIETY PROTECTION OFFICE
BELTSVILLE, MD 20705

EXHIBIT F
DECLARATION REGARDING DEPOSIT

NAME OF OWNER (S)	ADDRESS *(Street and No. or RD No., City, State, and Zip Code and Country)*	TEMPORARY OR EXPERIMENTAL DESIGNATION
Utah State University	4820 Old Main Hill Logan, UT 84322	VARIETY NAME Aquila
NAME OF OWNER REPRESENTATIVE (S)	**ADDRESS *(Street and No. or RD No., City, State, and Zip Code and Country)***	**FOR OFFICIAL USE ONLY**
Dr. Dominique Roche	4820 Old Main Hill Logan, UT 84322	PVPO NUMBER 200600040

I do hereby declare that during the life of the certificate a viable sample of propagating material of the subject variety will be deposited, and replenished as needed periodically, in a public repository in the United States in accordance with the regulations established by the Plant Variety Protection Office.

D Roche

Signature

10/20/05

Date